

The opinion in support of the decision being entered today was *not* written for publication and is *not* binding precedent of the Board.

**UNITED STATES PATENT AND TRADEMARK OFFICE**

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**BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES**

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*Ex parte* THOMAS A. RUNKLER and SHOUNAK ROYCHOWDHURY

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Appeal No. 2006-1307  
Application No. 09/553,956

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ON BRIEF

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Before RUGGIERO, BARRY, and MacDONALD, *Administrative Patent Judges*.  
BARRY, *Administrative Patent Judge*.

A patent examiner rejected claims 1-6, 10, 12-14, 16-23, 27, 29-31, and 33-36.<sup>1</sup>  
The appellants appeal therefrom under 35 U.S.C. § 134(a). We affirm-in-part.

**I. BACKGROUND**

The invention at issue on appeal concerns generating a "decision tree."  
A decision tree is a data structure that contains a hierarchical arrangement of rules that successively indicates how to classify an object into a plurality of classes. (Spec. at 1.)  
The appellants explain that their invention employs a unified approach to extracting a decision tree and fuzzy clusters. The decision tree is built by subsequent clustering of

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<sup>1</sup>In contrast, the examiner has allowed claims 7, 8, 24, and 25 and has objected to claims 15 and 32. (Examiner's Answer at 18.)

single dimensions or features, and the choice of the winning separation is based on cluster validity. In one embodiment, the clustering employs a fuzzy c-means ("FCM") model and a partition coefficient ("PC") to determine the selected separations.

(*Id.* at. 28.) A further understanding of the invention can be achieved by reading the following claims.

1. A method for refining a node of a decision tree associated with a plurality of data characterized by a plurality of features, comprising:

selecting a feature from among the features characterizing the data associated with the node;

performing a cluster analysis along the selected feature to group the data into one or more clusters based on distances between the data and respective one or more centers of the one or more clusters;

constructing one or more arcs of the decision tree at the node respectively for each of the one or more clusters;

projecting the data in each of the clusters, wherein the projected data are characterized by the plurality of the features but for the selected feature; and

recursively performing the steps of selecting a feature and performing the cluster analysis on the projected data in each of the clusters.

10. A method for generating a decision tree for a plurality of data characterized by a plurality of features, comprising:

performing a plurality of cluster analyses along each of the features to calculate a plurality of respective partition coefficients based on membership functions of the data for one or more clusters in respective said cluster analyses;

selecting the one of the features corresponding to a maximal partition coefficient from among the partition coefficients;

subdividing the data into one or more groups based on the selected feature; and

building the decision tree based on the one or more groups.

17. A method for generating a decision tree for a plurality of data characterized by a plurality of features, comprising:

performing a plurality of fuzzy cluster analyses along each of the features to calculate a maximal partition coefficient and a corresponding set of one or more fuzzy clusters, said maximal partition coefficient corresponding to one of the features;

selecting the one of the features corresponding to the maximal partition coefficient; and

building the decision tree based on the corresponding set of one or more fuzzy clusters.

Claims 1-5, 13, 18-22, and 30 stand rejected under 35 U.S.C. § 103(a) as obvious over *Fuzzy Decision Trees: Issues and Methods*, IEEE Transactions on Sys., Man and Cybernetics — Part B vol. 28, no. 1 (Feb. 1998) ("Janikow") and *On The Optimal Choice of Parameters in a Fuzzy C-Means Algorithm*, IEEE Int'l Conference on Fuzzy Sys. (Mar. 8-12, 1992) ("Choe"). Claims 6 and 23 stand rejected under § 103(a) as obvious over Janikow, Choe, and *SPRINT: A Scalable Parallel Classifier for Data Mining*, Proceedings of the 22d VLDB Conference Mumbai (Bombay), India (1996) ("Shafer"). Claims 10, 12, 16, 27, 29, and 33 stand rejected under § 103(a) as obvious

over Janikow. Claims 14 and 31 stand rejected under § 103(a) as obvious over Janikow and Shafer. Claims 17 and 34-36 stand rejected under 35 U.S.C. § 102(a) as anticipated by the appellants' admitted prior art ("AAPA").

Claims 1-3 and 18-20 stand rejected under § 103(a) as obvious over U.S. Patent No. 6,247,016 ("Rastogi") and *Data Clustering with Entropical Scheduling*, 1994 IEEE Int'l Conference, vol. 4, (June 27 - July 2, 1994) ("Shimoji"). Claims 4 and 21 stand rejected under § 103(a) as obvious over Rastogi, Shimoji, and AAPA. Claims 5 and 22 stand rejected under § 103(a) as obvious over Rastogi, Shimoji, AAPA, and *Generating Fuzzy Rules from Data*, Proceedings of the 5th IEEE Int'l Conference, vol. 3 (Sep. 8-11 1996) ("Hall"). Claims 6 and 23 stand rejected under § 103(a) as obvious over Rastogi, Shimoji, and Shafer.

## II. OPINION

Our opinion addresses the rejections in the following order:

- anticipation rejection of claims 17 and 34-36 by AAPA
- obviousness rejections of claims 10, 12-14, 16, 27, 29-31, and 33 involving Janikow
- obviousness rejection of claims 1-5 and 18-22 over Janikow and Choe
- obviousness rejection of claims 6 and 23 over Janikow, Choe, and Shafer
- obviousness rejections of claims 1-6 and 18-23 involving Rastogi and Shimoji.

A. ANTICIPATION REJECTION OF CLAIMS 17 AND 34-36 BY AAPA

"Rather than reiterate the positions of the examiner or the appellants *in toto*, we focus on the point of contention therebetween." *Ex parte Muresan*, No. 2004-1621, 2005 WL 951659, at \*1 (Bd.Pat.App & Int. Feb 10, 2005). The examiner asserts, "[T]he highest information gain is equated with the *maximal partition coefficient* because it *quantifies the goodness of the clustering*." (Examiner's Answer at 21.) The appellants argue that "quantifying the goodness of the clusters does not mean that any number that might have some connection to fuzzy clustering must be a partition coefficient." (Appeal Br. at 7.)

In addressing the point of contention, the Board conducts a two-step analysis. First, we construe the independent claims at issue to determine their scope. Second, we determine whether the construed claims are anticipated.

*1. Claim Construction*

"Analysis begins with a key legal question — *what is the invention claimed?*" *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561, 1567, 1 USPQ2d 1593, 1597 (Fed. Cir. 1987). In answering the question, "[c]laims must be read in view of the specification, of which they are a part." *Markman v. Westview Instruments, Inc.*, 52 F.3d 967, 979, 34 USPQ2d 1321, 1329 (Fed. Cir. 1995).

Here, independent claims 17 and 34 recite in pertinent part the following limitations: "performing a plurality of fuzzy cluster analyses along each of the features to calculate a maximal partition coefficient . . . ." Another part of the appellants' specification, moreover, discloses that the claimed partition coefficient is calculated according to the following equation:

$$PC(U_c^{(l)}) = \frac{1}{n} \sum_{k=1} \sum_{i=1} (u_{ikc}^{(l)})^2.$$

(Spec. at 15.) Reading the independent claims in view of the specification, the limitations require calculating a partition coefficient according to the aforementioned equation.

## 2. Anticipation Determination

"Having construed the claim limitations at issue, we now compare the claims to the prior art to determine if the prior art anticipates those claims." *In re Cruciferous Sprout Litig.*, 301 F.3d 1343, 1349, 64 USPQ2d 1202, 1206 (Fed. Cir. 2002). "A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros., Inc. v. Union Oil Co.*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987) (citing *Structural Rubber Prods. Co. v. Park Rubber Co.*, 749 F.2d 707, 715, 223 USPQ 1264, 1270 (Fed. Cir. 1984); *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548, 220

USPQ 193, 198 (Fed. Cir. 1983); *Kalman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 USPQ 781, 789 (Fed. Cir. 1983)). "[A]bsence from the reference of any claimed element negates anticipation." *Kloster Speedsteel AB v. Crucible, Inc.*, 793 F.2d 1565, 1571, 230 USPQ 81, 84 (Fed. Cir. 1986).

Here, the AAPA relied on by the examiner explains that "[a]s in ID3, FID3 generates its decision tree by maximizing information gains." (Spec. at 4.) In turn, "[t]he information gain is calculated by finding the average entropy of each attribute." (*Id.* at 3.) The examiner does not allege, let alone show, however, that such an information gain is calculated according to the aforementioned equation. Therefore, we reverse the rejection of claims 17 and 34, and of claims 35 and 36, which depend therefrom, as anticipated by AAPA.

B. OBVIOUSNESS REJECTIONS OF CLAIMS 10, 12-14, 16, 27, 29-31, AND 33  
INVOLVING JANIKOW

The examiner asserts that in Janikow "information gains as *partition coefficients for each of the attributes or features are calculated*. . . ." (Examiner's Answer at 24.) The appellants argue, "As explained above . . . , one of ordinary skill in the art would not confuse information gain with a partition coefficient." (Appeal Br. at 10.)

In addressing the point of contention, the Board conducts a two-step analysis. First, we construe the independent claims at issue to determine their scope. Second, we determine whether the construed claims would have been obvious.

### *1. Claim Construction*

Like independent claims 17 and 34, independent claims 10 and 27 require calculating a partition coefficient according to the aforementioned equation.

### *2. Obviousness Determination*

"Having determined what subject matter is being claimed, the next inquiry is whether the subject matter would have been obvious." *Ex Parte Massingill*, No. 2003-0506, 2004 WL 1646421, at \*3 (Bd.Pat.App & Int. 2004). "In rejecting claims under 35 U.S.C. Section 103, the examiner bears the initial burden of presenting a *prima facie* case of obviousness." *In re Rijckaert*, 9 F.3d 1531, 1532, 28 USPQ2d 1955, 1956 (Fed. Cir. 1993) (citing *In re Oetiker*, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992)). "A *prima facie* case of obviousness is established when the teachings from the prior art itself would appear to have suggested the claimed subject matter to a person of ordinary skill in the art." *In re Bell*, 991 F.2d 781, 783, 26 USPQ2d 1529, 1531 (Fed. Cir. 1993) (quoting *In re Rinehart*, 531 F.2d 1048, 1051, 189 USPQ 143, 147 (CCPA 1976)).



Here, Janikow calculates the information gain relied on by the examiner according to the following formula:

$$I^N = \sum_j |D_j| \log(w_j \cdot I^N(a_{ij}))$$

(P. 6.) The examiner does not allege, let alone show, however, that the formula used by the reference to calculate its information gain would have suggested the equation that the appellants use to calculate the claimed partition coefficient. Therefore, we reverse, the rejection of claims 10 and 27 and of claims 12, 16, 29, and 33, which depend therefrom, as obvious over Janikow.

Furthermore, the examiner does not allege, let alone show, that the addition of Choe or Shafer cures the aforementioned deficiency of Janikow. Therefore, we reverse the rejection of claims 13 and 30 as obvious over Janikow and Choe and the rejection of claims 14 and 31 as obvious over Janikow and Shafer.

#### C. OBVIOUSNESS REJECTION OF CLAIMS 1-5 AND 18-22 OVER JANIKOW AND CHOE

"When multiple claims subject to the same ground of rejection are argued as a group by appellant, the Board may select a single claim from the group of claims that are argued together to decide the appeal with respect to the group of claims as to the ground of rejection on the basis of the selected claim alone. Notwithstanding any other provision of this paragraph, the failure of appellant to separately argue claims which

appellant has grouped together shall constitute a waiver of any argument that the Board must consider the patentability of any grouped claim separately." 37 C.F.R.

§ 41.37(c)(1)(vii) (Sep. 30, 2004).

Here, the appellants argue claims 1-5 and 18-22, which are subject to the same ground of rejection, as a group. (Appeal Br. at 11-12.) We select claim 1 as the sole claim on which to decide the appeal of the group.

With this representation in mind, rather than reiterate the positions of the examiner or the appellants *in toto*, we focus on the point of contention therebetween. The examiner finds, "Janikow further discloses . . . ***recursively performing the steps of selecting a feature and performing the cluster analysis on the projected data in each of the clusters*** (Procedure to Build a Fuzzy Decision Tree, step 4, page 7:2, as suggested by Janikow, step 4 is performed at each node of the expanded tree,)." (Examiner's Answer at 12.) He further finds, "Choe discloses a Fuzzy C-Means Algorithm to maximize the number of data points in a cluster by using a fuzzy constraint. The Choe cluster analysis is ***based on distances between the data and respective one or more centers of the one or more cluster*** (Choe, Fuzzy C-Means Algorithm, pages 350-351)." (*Id.*) He then concludes, "It would have been obvious for one of ordinary skill in the art at the time the invention was made to modify the Janikow method by using the error constraint based on the distance between data and center of

cluster to build a decision tree in order to maximize the number of data points in a cluster." (*Id.*) The appellants make the following argument.

*Janikow* discloses a distinction between classification functions, e.g.  $f_2$ , and tree building functions, e.g.  $g_2$ . In fact, by keeping classification and tree building distinct, *Janikow* teaches against "recursively . . . performing the cluster analysis" in general and the proposed modification of *Janikow* to use *Choe et al.*'s classification system. Because of this distinction, *Janikow* actually teaches against using any classification function in *Choe et al.* for tree building. . . .

(Reply Br. at 5.)

"In addressing the point of contention, the Board conducts a two-step analysis. First, we construe the representative claim at issue to determine its scope. Second, we determine whether the construed claim would have been obvious." *Massingill*, at \*2.

### 1. Claim Construction

"[T]he PTO gives claims their 'broadest reasonable interpretation.'" *In re Bigio*, 381 F.3d 1320, 1324, 72 USPQ2d 1209, 1211 (Fed. Cir. 2004) (quoting *In re Hyatt*, 211 F.3d 1367, 1372, 54 USPQ2d 1664, 1668 (Fed. Cir. 2000)). "Moreover, limitations are not to be read into the claims from the specification." *In re Van Geuns*, 988 F.2d 1181, 1184, 26 USPQ2d 1057, 1059 (Fed. Cir. 1993) (citing *In re Zletz*, 893 F.2d 319, 321, 13 USPQ2d 1320, 1322 (Fed. Cir. 1989)).

Here, claim 1 recites in pertinent part the following limitations:

performing a cluster analysis along the selected feature to group the data into one or more clusters based on distances between the data and respective one or more centers of the one or more clusters;

. . . and

recursively performing the steps of selecting a feature and performing the cluster analysis on the projected data in each of the clusters.

Giving the representative claim its broadest, reasonable construction, the limitations require performing a cluster analysis along a selected feature to group data into one or more clusters based on distances between the data and respective one or more centers of the one or more clusters and recursively performing steps of selecting a feature and performing the cluster analysis on the projected data in each of the clusters.

## *2. Obviousness Determination*

The question of obviousness is "based on underlying factual determinations including . . . what th[e] prior art teaches explicitly and inherently. . . ." *In re Zurko*, 258 F.3d 1379, 1383, 59 USPQ2d 1693, 1696 (Fed. Cir. 2001) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17-18, 148 USPQ 459, 467 (1966); *In re Dembiczak*, 175 F.3d 994, 998, 50 USPQ2d 1614, 1616 (Fed. Cir. 1999); *In re Napier*, 55 F.3d 610, 613, 34 USPQ2d 1782, 1784 (Fed. Cir. 1995)). "After a *prima facie* case of obviousness has

been established, the burden of going forward shifts to the applicant." *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984).

Here, as noted by the examiner, *supra*, Step 4 of Janikow's "Procedure to Build a Fuzzy Decision Tree," (p. 7), is performed "[a]t each node, [to] search the set of remaining attributes from  $V - V^N$  to split the node. . . ." (*Id.*) More specifically, the Step "calculate[s] . . . the weighted information content," (*id.*), and "selects attribute  $V_i$  such that the informaiton gain . . . is maximal. . . ." (*Id.*) Because the calculation and selection are performed at each node, to search attributes remaining from the prior calculation and selection, we agree with the examiner's finding that the reference teaches the claimed recursive performance of selecting a feature and performing the cluster analysis on the projected data in each of the clusters.

Turning to the examiner's motivation for combining teachings of the references, we note that "[t]he presence or absence of a motivation to combine references in an obviousness determination is a pure question of fact." *In re Gartside*, 203 F.3d 1305, 1316, 53 USPQ2d 1769, 1776 (Fed. Cir. 2000) (citing *In re Dembiczak*, 175 F.3d 994, 1000, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999)). A suggestion to combine teachings from the prior art "may be found in explicit or implicit teachings within the references themselves, from the ordinary knowledge of those skilled in the art, or from the nature of the problem to be solved." *WMS Gaming Inc. v. Int'l Game Tech.*, 184 F.3d 1339,

1355, 51 USPQ2d 1385, 1397 (Fed. Cir. 1999) (citing *In re Rouffet*, 149 F.3d 1350, 1355, 47 USPQ2d 1453, 1456 (Fed. Cir. 1998)). Furthermore, "[s]ilence implies assent." *Harper & Row Publishers, Inc. v. Nation Enters.*, 471 U.S. 539, 572, 225 USPQ 1073, 1085 (1985)). Here, the examiner's finding that employing an FCM algorithm in building a decision tree would have maximized the number of data points in a cluster is uncontested.

In addition, "[a] reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994). Of course, "[a]rgument in the brief does not take the place of evidence in the record." *In re Schulze*, 346 F.2d 600, 602, 145 USPQ 716, 718 (CCPA 1965) (citing *In re Cole*, 326 F.2d 769, 773, 140 USPQ 230, 233 (CCPA 1964)).

Here, although *Janikow* may draw a distinction between classification functions and tree building functions, the appellants have not explained how, let alone persuaded us that, such a distinction would have discouraged a person of ordinary skill from the combination relied on by the examiner. Therefore, we affirm the rejection of claim 1 and of claims 2-5 and 18-22, which fall therewith, as obvious over *Janikow* and *Choe*.

D. OBVIOUSNESS REJECTION OF CLAIMS 6 AND 23 OVER JANIKOW, CHOE, AND SHAFER

The examiner admits, "Janikow and Choe . . . fails [sic] to disclose the step of ***performing the cluster analysis includes the step of performing a hard cluster analysis***. (Examiner's Answer at 14.) Observing that "[t]he Shafer technique, in order to have non-overlapping groups, recursively partitioning the data until each partition is either pure or sufficiently meet a requirement, e.g., a parameter set by the user, and using function value  $(A) < x$  to analyze attributes (Shafer, page 545:2 to 546:1)," (*id.* at 27), however, he alleges, "As seen, *value*  $(A) < x$  is ***a hard cluster analysis*** for building the decision tree." (*Id.*) The "[a]ppellants respectfully submit that one skilled in the art would not ordinarily recognize this function as a cluster analysis, much less as a hard cluster analysis." (Reply Br. at 6.)

"A rejection based on section 103 clearly must rest on a factual basis. . . ." *In re Warner*, 379 F.2d 1011, 1017, 154 USPQ 173, 178 (CCPA 1967). "The Patent Office has the initial duty of supplying the factual basis for its rejection. It may not . . . resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in its factual basis." *Id.*

Here, the appellants' observations that Shafer "makes no mention of any 'cluster analysis,' much less 'performing a hard cluster analysis,'" (Reply Br. at 6), is uncontested. Furthermore, we will not speculate or assume that Shafer's  $(A) < x$

is a hard cluster analysis for building the decision tree. Therefore, we reverse the rejection of claims 6 and 23 as obvious over Janikow, Choe, and Shafer.

E. OBVIOUSNESS REJECTIONS OF CLAIMS 1-6 AND 18-23 INVOLVING RASTOGI AND SHIMOJI

The examiner admits, "Rastogy [sic] does not explicitly teach the cluster analysis is ***based on distances between the data and respective one of more centers of the one or more clusters***. (Examiner's Answer at 8.) He concludes, however, that "it would have been obvious for one of ordinary skill in the art at the time the invention was made to combine clustering error as taught by Shimoji to analyze a cluster when grouping data into one or more cluster of a decision tree." (*Id.*) The appellants make the following argument.

[A]ny type of added "cluster analysis" would be technically infeasible, as Rastogi et al. already discloses an equation for entropy for a set of records, based on relative frequencies of respective classes in the set (e.g., "the more homogeneous a set is with respect to the classes of records in the set, the lower is the entropy"), and an equation for entropy of a split to divide the set, and states, "Consequently, the split with the least entropy best separates classes, and is thus chosen as the best split for a node." Thus, there is no motivation to combine Rastogi et al. and Shimoji et al., other than impermissible hindsight.

(Appeal Br. at 15.)

"Obviousness may not be established using hindsight or in view of the teachings or suggestions of the inventor." *Para-Ordnance Mfg. v. SGS Importers Int'l*, 73 F.3d 1085, 1087, 37 USPQ2d 1237, 1239 (Fed. Cir. 1995) (citing *W.L. Gore & Assocs., Inc.*



*v. Garlock, Inc.*, 721 F.2d 1540, 1551, 1553, 220 USPQ 303, 312-13 (Fed. Cir. 1983)).

The mere fact that prior art may be modified in a manner suggested by an examiner, moreover, does not make the modification obvious unless the prior art suggested the desirability thereof. *In re Fritch*, 972 F.2d 1260, 1266, 23 USPQ2d 1780, 1783-84 (Fed. Cir. 1992); *In re Gordon*, 733 F.2d 900, 902, 221 USPQ 1125, 1127 (Fed. Cir. 1984).

Here, the examiner does not allege, let alone show, any advantage that would have been gained by his proposed combination. Therefore, we reverse the obviousness rejection of claims 1-3 and 18-20 as obvious over Rastogi and Shimoji.

Nor does the examiner allege, let alone show, that the addition of AAPA, Hall, or Shafer cures the aforementioned deficiency of Rastogi and Shimoji. Therefore, we reverse the rejection of claims 4 and 21 as obvious over Rastogi, Shimoji, and AAPA; the rejection of claims 5 and 22 as obvious over Rastogi, Shimoji, AAPA, and Hall; and the rejection of claims 6 and 23 as obvious over Rastogi, Shimoji, and Shafer.

### III. CONCLUSION


In summary, the rejection of claims 1-3 and 18-20 over Rastogi and Shimoji; the rejections of claims 4 and 21 over Rastogi, Shimoji, and AAPA; the rejection of claims 5 and 22 over Rastogi, Shimoji, AAPA, and Hall; and the rejection of claims 6 and 23 over Rastogi, Shimoji, and Shafer are reversed. The rejection of claims 1-5 and

18-22 over Janikow and Choe is affirmed, but the rejection of claims 6 and 23 over Janikow, Choe, and Shafer is reversed. The rejection of claims 10, 12, 16, 27, 29, and 33 over Janikow; the rejection of claims 13 and 30 over Janikow and Choe; the rejection of claims 14 and 31 over Janikow and Shafer; and the rejection of claims 17 and 34-36 by AAPA are reversed.

"Any arguments or authorities not included in the brief or a reply brief filed pursuant to [37 C.F.R.] § 41.41 will be refused consideration by the Board, unless good cause is shown." 37 C.F.R. § 41.37(c)(1)(vii). Accordingly, our affirmance is based only on the arguments made in the briefs. Any arguments or authorities omitted therefrom are neither before us nor at issue but are considered waived. *Cf. In re Watts*, 354 F.3d 1362, 1367, 69 USPQ2d 1453, 1457 (Fed. Cir. 2004) ("[I]t is important that the applicant challenging a decision not be permitted to raise arguments on appeal that were not presented to the Board.") No time for taking any action connected with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

  
JOSEPH F. RUGGIERO  
Administrative Patent Judge

BOARD OF PATENT  
APPEALS  
AND  
INTERFERENCES

  
ALLEN R. MacDonald  
Administrative Patent Judge

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HICKMAN PALERMO TRUONG & BECKER/ORACLE  
2055 GATEWAY PLACE  
SUITE 550  
SAN JOSE CA 95110-1089